APPENDIX D

LOW IMPACT DEVELOPMENT CONCEPTS

RAIN GARDENS

A how-to manual
for homeowners

RAIN GARDENS

Your personal contribution to cleaner water

Homeowners in many parts of the country are catching on to rain gardens – landscaped areas planted to wild flowers and other native vegetation that soak up rain water, mainly from the roof of a house or other building. The rain garden fills with a few inches of water after a storm and the water slowly filters into the ground rather than running off to a storm drain. Compared to a conventional patch of lawn, a rain garden allows about 30% more water to soak into the ground.

Why are rain gardens important? As cities and suburbs grow and replace forests and agricultural land, increased stormwater runoff from impervious surfaces becomes a problem. Stormwater runoff from developed areas increases flooding; carries pollutants from streets, parking lots and even lawns into local streams and lakes; and leads to costly municipal improvements in stormwater treatment structures.

By reducing stormwater runoff, rain gardens can be a valuable part of changing these trends. While an individual rain garden may seem like a small thing, collectively they produce substantial neighborhood and community environmental benefits. Rain gardens work for us in several ways:

- Increasing the amount of water that filters into the ground, which recharges local and regional aquifers;
- Helping protect communities from flooding and drainage problems;
- Helping protect streams and lakes from pollutants carried by urban stormwater – lawn fertilizers and pesticides, oil and other fluids that leak from cars, and numerous harmful substances that wash off roofs and paved areas;
- Enhancing the beauty of yards and neighborhoods;
- Providing valuable habitat for birds, butterflies and many beneficial insects.

Who should use this manual?

This manual provides homeowners and landscape professionals with the information needed to design and build rain gardens on residential lots. Guidelines presented in this manual can also be used to treat roof runoff at commercial and institutional sites. However, the manual should not be used to design rain gardens for parking lots, busy streets and other heavily used paved areas where stormwater would require pretreatment before entering a rain garden.

Frequently asked questions

Does a rain garden form a pond?

No. The rain water will soak in so the rain garden is dry between rainfalls. (Note: some rain gardens can be designed to include a permanent pond, but that type of rain garden is not addressed in this publication).

Are they a breeding ground for mosquitoes?

No. Mosquitoes need 7 to 12 days to lay and hatch eggs, and standing water in the rain garden will last for a few hours after most storms. Mosquitoes are more likely to lay eggs in bird baths, storm sewers, and lawns than in a sunny rain garden. Also rain gardens attract dragonflies, which eat mosquitoes!

Do they require a lot of maintenance?

Rain gardens can be maintained with little effort after the plants are established. Some weeding and watering will be needed in the first two years, and perhaps some thinning in later years as the plants mature.

Is a rain garden expensive?

It doesn't have to be. A family and a few friends can provide the labor. The main cost will be purchasing the plants, and even this cost can be minimized by using some native plants that might already exist in the yard or in a neighbor's yard.

Step 1 Sizing and Siting the Rain Garden

This section of the manual covers rain garden basics – where to put the rain garden, how big to make it, how deep to dig it, and what kind of soils and slope are best. Following the instructions in this section is the best way to ensure a successful rain garden project.

An extension of PVC pipe helps direct downspout water to this rain garden.

If you already know the size you want your rain garden to be, then skip ahead to the section about building the rain garden. However, take time read the pointers about location, and do find the slope of the lawn. If the location has a slope more than about 12%, it's best to pick a different location because of the effort it will take to create a level rain garden.

Where should the rain garden go?

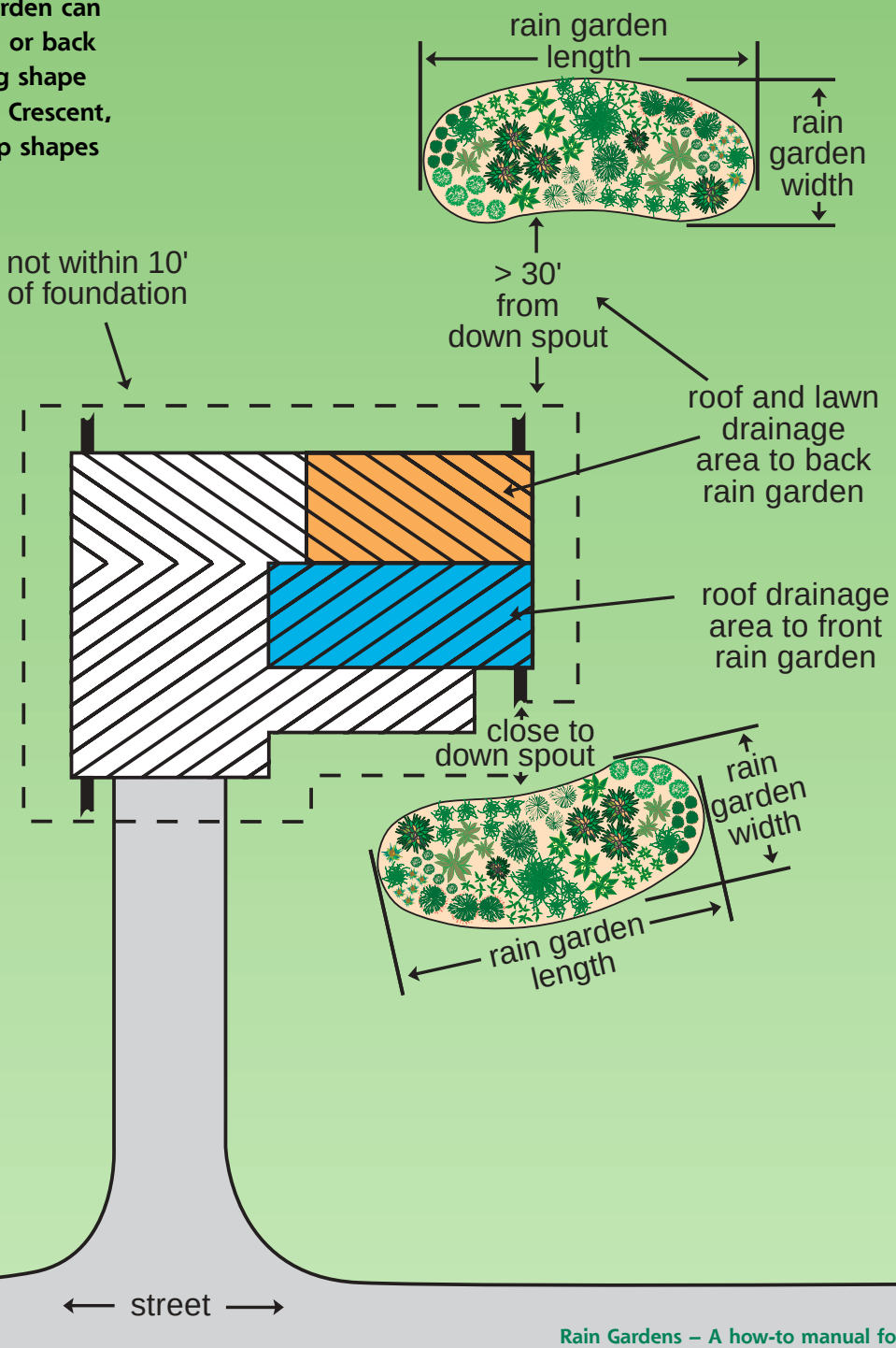
Home rain gardens can be in one of two places – near the house to catch only roof runoff or farther out on the lawn to collect water from the lawn and roof. (Figure 1 shows the possible locations on a residential lot.) To help decide where to put a rain garden, consider these points:

- The rain garden should be at least 10 feet from the house so infiltrating water doesn't seep into the foundation.
- Do not place the rain garden directly over a septic system.
- It may be tempting to put the rain garden in a part of the yard where water already ponds. Don't! The goal of a rain garden is to encourage infiltration, and your yard's wet patches show where infiltration is slow.
- It is better to build the rain garden in full or partial sun, not directly under a big tree.
- Putting the rain garden in a flatter part of the yard will make digging much easier. For example, a rain garden 10 feet wide on a 10% slope must be 12 inches deep to be level, unless you import topsoil or use cut and fill.

Consider your overall landscape

When considering placement of your rain garden, design with the end in mind. Carefully consider how the rain garden can be integrated into existing and future landscaping. Also, pay attention to views from inside the house as well as those throughout the landscape. Determine how far or how close you want your rain garden to outdoor gathering spaces or other play areas. Why not locate it near a patio where you can take advantage of the colors and fragrances for hours on end!

Figure 1 **A rain garden can be built in the front or back yard. Pick a pleasing shape for the rain garden. Crescent, kidney, and teardrop shapes seem to work well.**



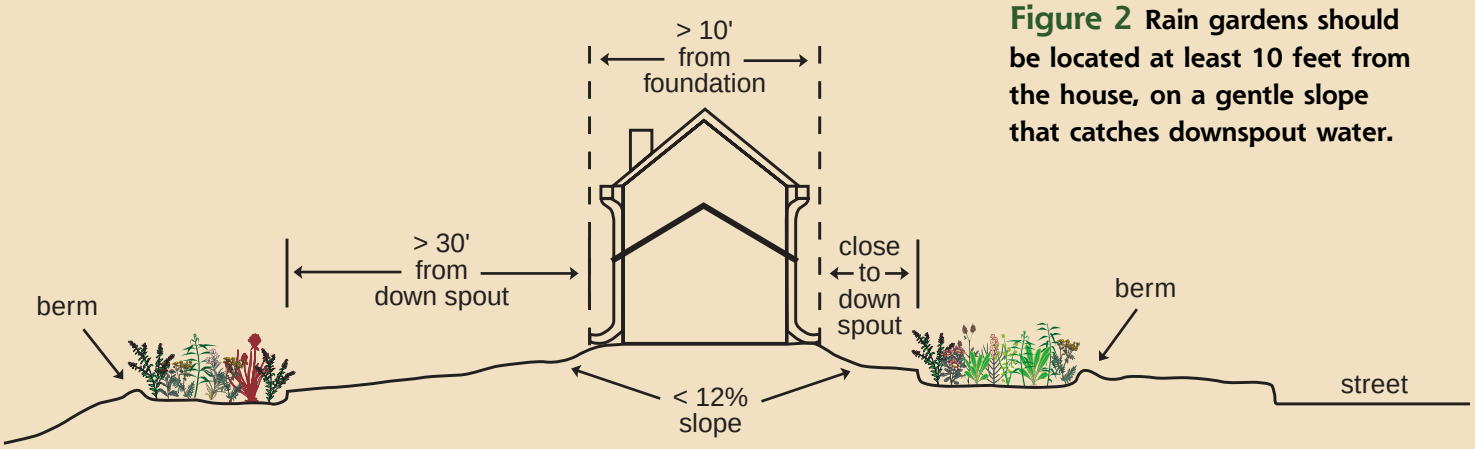


Figure 2 **Rain gardens should be located at least 10 feet from the house, on a gentle slope that catches downspout water.**

How big should the rain garden be?

The surface area of the rain garden can be almost any size, but time and cost will always be important considerations in sizing decisions. Any reasonably sized rain garden will provide some stormwater runoff control. A typical residential rain garden ranges from 100 to 300 square feet. Rain gardens can be smaller than 100 square feet, but very small gardens have little plant variety. If a rain garden is larger than 300 square feet it takes a lot more time to dig, is more difficult to make level, and could be hard on your budget.

The size of the rain garden will depend on

- how deep the garden will be,
- what type of soils the garden will be planted in, and
- how much roof and/or lawn will drain to the garden.

This information, along with the sizing factor from the tables on page 9, will determine the surface area of the rain garden.

Digging with a rented backhoe.

Guidelines are not rules...

The sizing guidelines described in this manual are based on a goal of controlling 100% of the runoff for the average rainfall year while keeping the size of the rain garden reasonable. Establishing a 100% runoff goal helps compensate for some of the errors that creep into the design and construction of any rain garden.

If you follow the guidelines in the manual and decide the calculated surface area is just too large for your goals, it is perfectly acceptable to make the rain garden smaller. The rain garden can be up to 30% smaller and still control almost 90% of the annual runoff. On the other hand, it is fine to make the rain garden bigger than the guidelines indicate.

How Deep Should the Rain Garden Be?

A typical rain garden is between four and eight inches deep. A rain garden more than eight inches deep might pond water too long, look like a hole in the ground, and present a tripping hazard for somebody stepping into it. A rain garden much less than four inches deep will need an excessive amount of surface area to provide enough water storage to infiltrate the larger storms.

No matter what the depth of the rain garden, the goal is to keep the garden level. Digging a very shallow rain garden on a steep lawn will require bringing in extra topsoil to bring the downslope part of the garden up to the same height as the up-slope part of the garden. As the slope gets steeper, it is easier to dig the rain garden a little deeper to make it level.

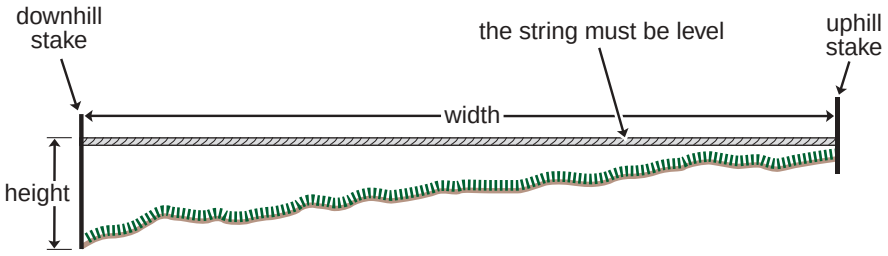


Figure 3 The string should be tied to the base of the uphill stake, then tied to the downhill stake at the same level.

The slope of the lawn should determine the depth of the rain garden. Find the slope of your lawn by following these steps. (Figure 3 shows how the stakes and string should look.)

1. Pound one stake in at the uphill end of your rain garden site and pound the other stake in at the downhill end. The stakes should be about 15 feet apart.
2. Tie a string to the bottom of the uphill stake and run the string to the downhill stake.
3. Using a string level or the carpenter's level, make the string horizontal and tie the string to the downhill stake at that height.
4. Measure the width (in inches) between the two stakes.
5. Now measure the height (in inches) on the downhill stake between the ground and string.
6. Divide the height by the width and multiply the result by 100 to find the lawn's percent slope. If the slope is more than 12%, it's best to find another site or talk to a professional landscaper.

Using the slope of the lawn, select the depth of the rain garden from the following options:

- If the slope is less than 4%, it is easiest to build a 3 to 5-inch deep rain garden.
- If the slope is between 5 and 7%, it is easiest to build one 6 to 7 inches deep.
- If the slope is between 8 and 12%, it is easiest to build one about 8 inches deep.

EXAMPLE

Todd measures the length of the string between the stakes; it is 180 inches long. The height is 9 inches. He divides the height by the width to find his lawn's percent slope.

$$\frac{\text{height}}{\text{width}} \times 100 = \%\ \text{slope} \qquad \frac{9\ \text{inches}}{180\ \text{inches}} \times 100 = 5\%\ \text{slope}$$

With a 5% slope, Todd should build a 6 inch deep rain garden.

What type of soils are on the rain garden site?

After choosing a rain garden depth, identify the lawn's soil type as sandy, silty, or clayey. Sandy soils have the fastest infiltration; clayey soils have the slowest. Since clayey soils take longer to absorb water, rain gardens in clayey soil must be bigger than rain gardens in sandy or silty soil. If the soil feels very gritty and coarse, you probably have sandy soil. If your soil is smooth but not sticky, you have silty soil. If it is very sticky and clumpy, you probably have clayey soil.

How big is the area draining to the rain garden?

The next step in choosing your rain garden size is to find the area that will drain to the rain garden. As the size of the drainage area increases so should the size of the rain garden. There is some guesswork in determining the size of a drainage area, especially if a large part of the lawn is up-slope from the proposed garden site. Use the suggestions below to estimate the drainage area without spending a lot of time.

Rain gardens less than 30 feet from the downspout

1. In this case, where the rain garden is close to the house, almost all water will come from the roof downspout. Walk around the house and estimate what percent of the roof feeds to that downspout. Many houses have four downspouts, each taking about 25% of the roof's runoff.
2. Next find your home's footprint, the area of the first floor. If you don't already know it, use a tape measure to find your house's length and width. Multiply the two together to find the approximate area of your roof.
3. Finally, multiply the roof area by the percent of the roof that feeds to the rain garden downspout. This is the roof drainage area.

If the rain garden is far from the house, and you don't want a swale or downspout cutting across the lawn, run a PVC pipe underground from the downspout to the rain garden. In this case do calculations as for a rain garden less than 30 feet from the house.

Rain gardens more than 30 feet from the downspout

1. If there is a significant area of lawn uphill that will also drain to the rain garden, add this lawn area to the roof drainage area. First find the roof drainage area using the steps above for a rain garden less than 30' from the downspout.
2. Next find the area of the lawn that will drain to the rain garden. Stand where your rain garden will be and look up toward the house. Identify the part of the lawn sloping into the rain garden.
3. Measure the length and width of the uphill lawn, and multiply them to find the lawn area.
4. Add the lawn area to the roof drainage area to find the total drainage area.

EXAMPLE

Todd's house is 60 feet by 40 feet, so the roof area is 2400 square feet. He estimates that the downspout collects water from 25% of the roof, so he multiplies 2400 by 0.25 to get a downspout drainage area of 600 square feet.

Roof Area: 60 ft by 40 ft = 2400 square ft.

Drainage Area: 2400 square ft. x 0.25 = 600 square ft.

Simple soil tests

Two small tests can ensure your soil can handle a rain garden:

- Dig a hole about 6 inches deep where the rain garden is to go and fill the hole with water. If the water takes more than 24 hours to soak in, the soil is not suitable for a rain garden.
- Take a handful of soil and dampen it with a few drops of water. After kneading the soil in your fingers, squeeze the soil into a ball. If it remains in a ball, then work the soil between your forefinger and thumb, squeezing it upward into a ribbon of uniform thickness. Allow the ribbon to emerge and extend over the forefinger until it breaks from its own weight. If the soil forms a ribbon more than an inch long before it breaks, and it also feels more smooth than gritty, the soil is not suitable for a rain garden.

The map is a starting point for assessing what type of soils you might find in your yard. However, the soil on a small plot of a yard can be very different from the soils indicated on the map. Use the simple soil test described here for a more accurate representation of the soils in the possible rain garden location. More information about sampling and testing lawn and garden soils can be obtained at county UW-Extension offices.

Using the Rain Garden Size Factors

Having estimated the drainage area, soil type, and depth for your rain garden, use Table 1 or Table 2 to determine the rain garden's surface area. Use Table 1 if the rain garden is less than 30 feet from the downspout, and use Table 2 if it is more than 30 feet from the downspout.

Table 1 Rain gardens less than 30 feet from downspout.

	3-5 in. deep	6-7 in. deep	8 in. deep
Sandy soil	0.19	0.15	0.08
Silty soil	0.34	0.25	0.16
Clayey soil	0.43	0.32	0.20

Table 2 Rain gardens more than 30 feet from downspout.

	Size Factor, for all depths
Sandy soil	0.03
Silty soil	0.06
Clayey soil	0.10

1. Find the size factor for the soil type and rain garden depth.
2. Multiply the size factor by the drainage area. This number is the recommended rain garden area.
3. If the recommended rain garden area is much more than 300 square feet, divide it into smaller rain gardens.

EXAMPLE

Todd's rain garden is less than 30 feet from the downspout, and his lawn has a 5% slope, so he will have a 6-inch deep rain garden. His lawn is silty, so Table 1 recommends a size factor of 0.25. He multiplies the downspout drainage area, 600 square feet, by 0.25 to find the recommended rain garden area, 150 square feet.

600 square ft. by 0.25 = 150 square ft.

Runoff flows into a new rain garden (shown before plants are fully grown).

How long and how wide should the rain garden be?

Before building the rain garden, think about how it will catch water. Runoff will flow out of a downspout and should spread evenly across the entire length of the rain garden. The rain garden must be as level as possible so water doesn't pool at one end and spill over before it has a chance to infiltrate.

Choose a size that is best for your yard

Remember that these are only guidelines. The size of the rain garden also depends on how much money you want to spend, how much room you have in your yard, and how much runoff you want to control. Again, you can reduce the size of your rain garden by as much as 30% and still control almost 90% of the runoff. If the sizing table suggests that the rain garden be 200 square feet, but there is only enough room for a 140-square-foot rain garden, that's fine. A smaller rain garden will usually work to control most stormwater runoff, although some bigger storms might over-top the berm.

The longer side of the rain garden should face upslope; that is, the length of the rain garden should be perpendicular to the slope and the downspout. This way the garden catches as much water as possible. However, the rain garden should still be wide enough for the water to spread evenly over the whole bottom and to provide the space to plant a variety of plants. A good rule of thumb is that the rain garden should be about twice as long (perpendicular to the slope) as it is wide.

When choosing the width of the garden, think about the slope of the lawn. Wide rain gardens and rain gardens on steep slopes will need to be dug very deep at one end in order to be level. If the rain garden is too wide, it may be necessary to bring in additional soil to fill up the downhill half. Experience shows that making a rain garden about 10 feet wide is a good compromise between the effect of slope and how deep the rain garden should be. A rain garden should have a maximum width of about 15 feet, especially for lawns with more than about an 8 percent slope.

To determine the length of the rain garden:

1. Pick the best rain garden width for your lawn and landscaping.
2. Divide the size of your rain garden by the width to find your rain garden's length.

EXAMPLE

Todd wants a 10-foot wide rain garden, so he divides 150 by 10 to find the rain garden length, 15 feet.

$$\frac{\text{rain garden area}}{\text{width}} = \text{length} \qquad \frac{150\ \text{ft}^2}{10\ \text{ft}} = 15\ \text{ft}$$

Step 2 Building the Rain Garden

Now that the size and place for the rain garden are set, it's time to get a shovel and start digging. Working alone, it will take about six hours to dig an average-size rain garden. If friends help it will go much faster, possibly only an hour or two.

Before you start digging, call Digger's Hotline at 1-800-242-8511.

If you are building the rain garden into an existing lawn, digging time can be reduced by killing the grass first. A chemical such as Round-Up can be used, but a more environmentally friendly approach is to place black plastic over the lawn until the grass dies. Also, the best time to build the rain garden is in the spring. It will be easier to dig, and the plants are more likely to thrive.

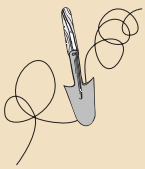
A note on tools

The following tools will help in building the rain garden. Some of the tools are optional.

- **Tape measure**

- **Shovels**
- **Rakes**
- **Trowels**
- **Carpenter's level**

- **Wood stakes, at least 2 ft long**



- **String**
- **2x4 board, at least 6 ft long (optional)**
- **Small backhoe with caterpillar treads (optional)**

Leveling the rain garden

One way to check the level of the rain garden is to just "eyeball" it. To do it more accurately follow these steps:

- **When the whole area has been dug out to about the right depth, lay the 2x4 board in the rain garden with the carpenter's level sitting on it. Find the spots that aren't flat. Fill in the low places and dig out the high places.**
- **Move the board to different places and different directions, filling and digging as necessary to make the surface level.**
- **When the rain garden is as level as you can get it, rake the soil smooth.**

The perimeter of a rain garden is defined with string before digging.

Digging the rain garden

While digging the rain garden to the correct depth, heap the soil around the edge where the berm will be. (The berm is a low "wall" around three sides of the rain garden that holds the water in during a storm.) On a steeper lawn the lower part of the rain garden can be filled in with soil from the uphill half, and extra soil might need to be brought in for the berm.

Start by laying string around the perimeter of your rain garden. Remember that the berm will go outside the string. Next, put stakes along the uphill and downhill sides, lining them up so that each uphill stake has a stake directly downhill. Place one stake every 5 feet along the length of the rain garden.

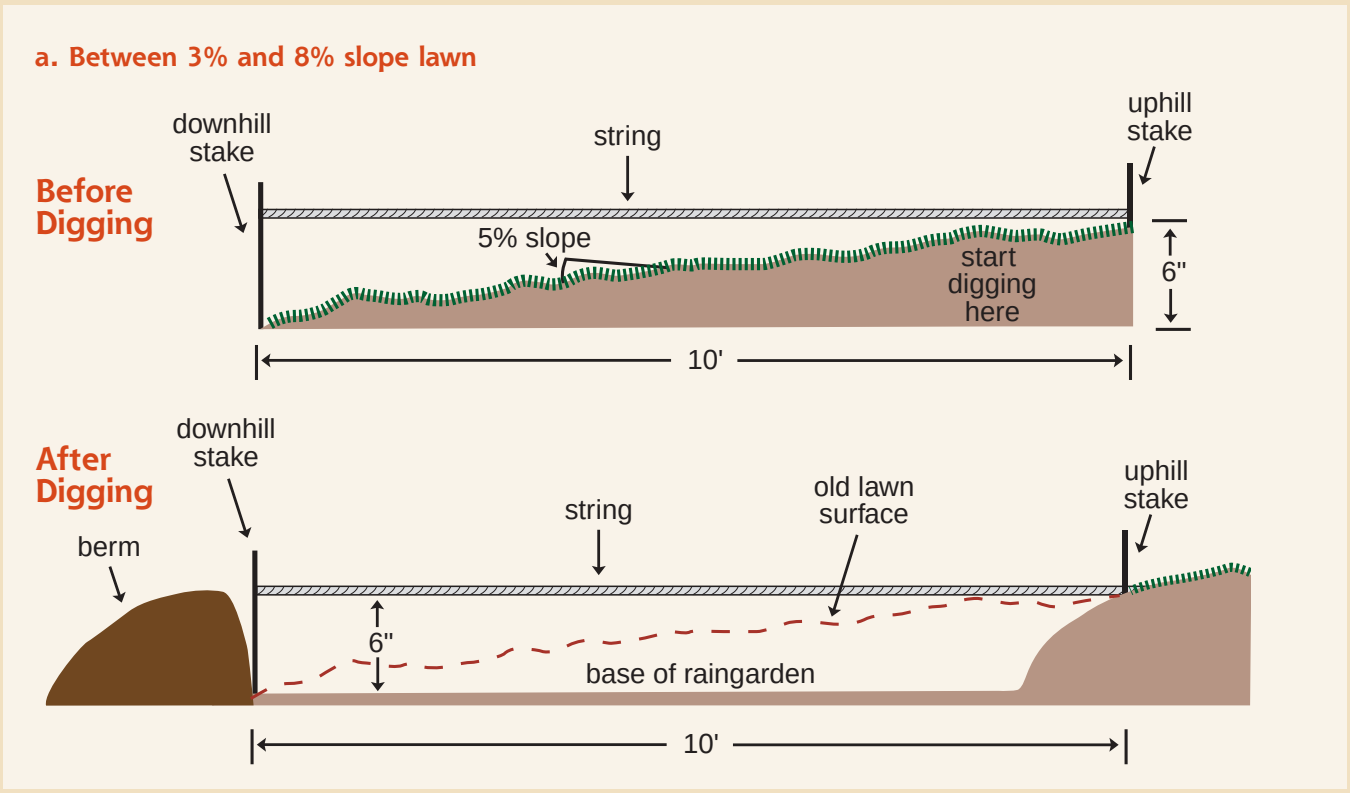
Start at one end of the rain garden and tie a string to the uphill stake at ground level. Tie it to the stake directly downhill so that the string is level. Work in 5-foot-wide sections, with only one string at a time. Otherwise the strings will become an obstacle.

Start digging at the uphill side of the string. Measure down from the string and dig until you reach the depth you want the rain garden to be. If the rain garden will be four inches deep, then dig four inches down from the string. Figure 4 shows how.

If the lawn is almost flat, you will be digging at the same depth throughout the rain garden and using the soil for the berm. If the lawn is steeper, the high end of the rain garden will need to be dug out noticeably more than the low end, and some of the soil from the upper end can be used in the lower end to make the rain garden level. Continue digging and filling one section at a time across the length of your rain garden until it is as level as possible.

In any garden, compost will help the plants become established and now is the time to mix in compost if needed. Using a roto-tiller can make mixing much easier, but isn't necessary. If you do add compost, dig the rain garden a bit deeper. To add two inches of compost, dig the rain garden one to two inches deeper than planned.

Figure 4 **Where to dig and where to put the soil you've dug.**



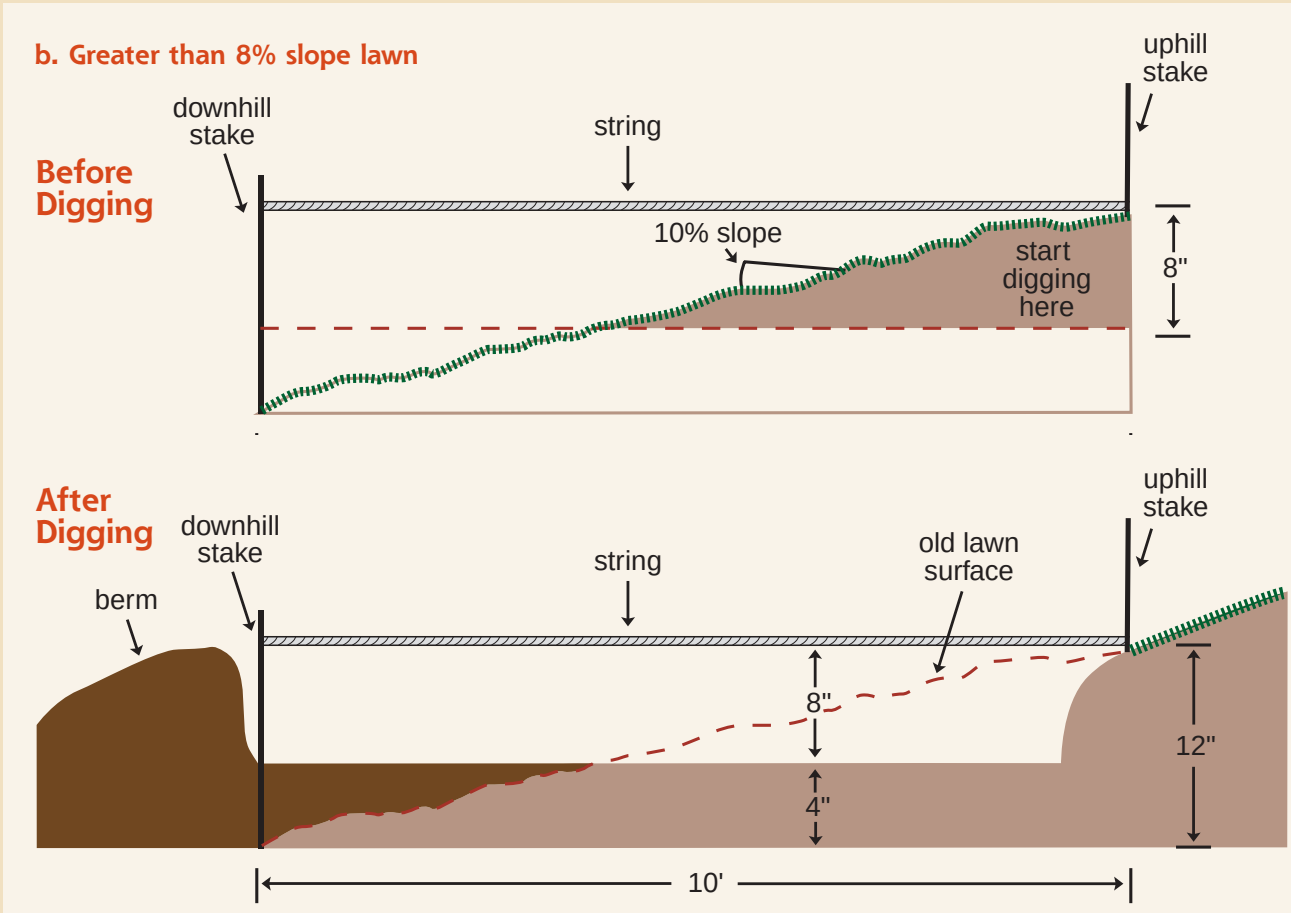


Figure 5 **The top of the downhill part of the berm should come up to the same elevation as the entry to the rain garden at the uphill end.**

On a gentle slope, soil from digging out the garden can be used to create the berm. This rain garden is 4 inches deep.

Making the Berm

Water flowing intro the rain garden will naturally try to run off the downhill edge. A berm is needed to keep the water in the garden, The berm is a "wall" across the bottom and up the sides of the rain garden. The berm will need to be highest at the downhill side. Up the sides of the rain garden, the berm will become lower and gradually taper off by the time it reaches the top of the rain garden. Figure 5 shows how the berm should look.

On a flat slope there should be plenty of soil from digging out the rain garden to use for a berm. On a steeper slope, most of the soil from the uphill part of the rain garden was probably used to fill in the downhill half, and soil will have to be brought in from somewhere else. After shaping the berm into a smooth ridge about a foot across, stomp on it. It is very important to have a well-compacted berm, so stomp hard. The berm should have very gently sloping sides; this helps smoothly integrate the rain garden with the surrounding lawn and also makes the berm less susceptible to erosion.

To prevent erosion, cover the berm with mulch or plant grass. Use straw or erosion-control mat to protect the berm from erosion while the grass is taking root.

If you don't want to plant grass or mulch over the outside of the berm, you can also plant dry-tolerant prairie species. Some potential berm species are prairie dropseed, little bluestem, prairie smoke, blue-eyed grass, prairie phlox, and shooting star.

Note: If the downspout is a few feet from the entry to the rain garden, make sure the water runs into the garden by either digging a shallow grass swale or attaching an extension to the downspout.

Tips for designing an attractive rain garden

While rain gardens are a highly functional way to help protect water quality, they are also gardens and should be an attractive part of your yard and neighborhood. Think of the rain garden in the context of your home's overall landscape design. Here are a few tips:

When choosing native plants for the garden, it is important to consider the height of each plant, bloom time and color, and its overall texture. Use plants that bloom at different times to create a long flowering season. Mix heights, shapes, and textures to give the garden depth and dimension. This will keep the rain garden looking interesting even when few wildflowers are in bloom.

When laying plants out, randomly clump individual species in groups of 3 to 7 plants to provide a bolder statement of color. Make sure to repeat these individual groupings to create repetition and cohesion in a planting. This will provide a more traditional formal look to the planting.

Try incorporating a diverse mixture of sedges, rushes, and grasses with your flowering species (forbs). This creates necessary root competition that will allow plants to follow their normal growth patterns and not outgrow or out-compete other species. In natural areas, a diversity of plant types not only adds beauty but also create a thick underground root matrix that keeps the entire plant community in balance. In fact, 80% of the plant mass in native prairie communities is underground. Once the rain garden has matured and your sedges, rushes and grasses have established a deep, thick root system, there will be less change in species location from year to year, and weeds will naturally decline.

Finally, consider enhancing the rain garden by using local or existing stone, ornamental fences, trails, garden benches, or additional wildflower plantings. This will help give the new garden an intentional and cohesive look and provide a feeling of neatness that the neighbors will appreciate.

Step 3 Planting and Maintaining the Rain Garden

Planting the rain garden is the fun part! A number of planting designs and lists of suggested plants are included at the end of this publication. Use these for ideas, but don't be afraid to be creative – there's no single best way to plant a rain garden. Anyone who has ever done any gardening will have no problem planting a rain garden, but a few basic reminders are listed below.

Planting the rain garden

Select plants that have a well established root system. Usually one or two-year-old plants will have root systems that are beginning to circle or get matted. (Note: use only nursery-propagated plants; do not collect plants from the wild).

Make sure to have at least a rough plan for which plants will be planted where. Lay out the plants as planned one foot apart in a grid pattern, keeping them in containers if possible until they are actually planted to prevent drying out before they get in the ground.

Dig each hole twice as wide as the plant plug and deep enough to keep the crown of the young plant level with the existing grade (just as it was growing in the cell pack or container). Make sure the crown is level and then fill the hole and firmly tamp around the roots to avoid air pockets.

Apply double-shredded mulch evenly over the bed approximately two inches thick, but avoid burying the crowns of the new transplants. Mulching is usually not necessary after the second growing season unless the "mulched look" is desired.

Stick plant labels next to each individual grouping. This will help identify the young native plants from non-desirable species (weeds) as you weed the garden.

As a general rule plants need one inch of water per week. Water immediately after planting and continue to water twice a week (unless rain does the job) until the plugs are established. You should not have to water your rain garden once the plants are established. Plugs can be planted anytime during the growing season as long as they get adequate water.

Fire safety

Make sure burning is allowed in your locale. If so, be sure to notify the local fire department and obtain a burn permit if needed. It's also wise – not to mention neighborly – to make sure the neighbors know that you're burning and that all safety precautions are being taken. Basic fire precautions include:

- **Make sure there is a fire-break (non-burnable area, such as turfgrass) at least 10-feet wide surrounding the area to be burned.**
- **Never burn on windy days.**
- **Never leave an actively burning fire unattended.**
- **Keep a garden hose handy in case fire strays where it is not wanted. Also have a metal leaf rake in hand to beat out flames that creep beyond the burn zone.**

Maintaining the rain garden

Weeding will be needed the first couple of years. Remove by hand only those plants you are certain are weeds. Try to get out all the roots of the weedy plants. Weeds may not be a problem in the second season, depending on the variety and tenacity of weeds present. In the third year and beyond, the native grasses, sedges, rushes, and wildflowers will begin to mature and will out-compete the weeds. Weeding isolated patches might still be needed on occasion.

After each growing season, the stems and seedheads can be left for winter interest, wildlife cover and bird food. Once spring arrives and new growth is 4-6-inches tall, cut all tattered plants back. If the growth is really thick, hand-cut the largest plants and then use a string trimmer to mow the planting back to a height of six to eight inches. Dead plant material can also be removed with a string trimmer or weed whacker (scythe) and composted or disposed of as appropriate.

The best way to knock back weeds and stimulate native plant growth is to burn off the dead plant material in the rain garden. However, burning is banned in most municipalities. Another option is to mow the dead plant material. If the mowing deck of your lawn mower can be raised to a height of six inches or so, go ahead and simply mow your rain garden. Then, rake up and compost or properly dispose of the dead plant material.

If the mower deck won't raise that high, use a string trimmer or weed-eater to cut the stems at a height of 6-8 inches. On thicker stems, such as cup plant, goldenrods and some asters, a string trimmer may not be strong enough. For these, use hand clippers or pruning shears to cut the individual stems.

What does a rain garden cost?

The cost of a rain garden will vary depending on who does the work and where the plants come from. If you grow your own plants or borrow plants from neighbors there can be very little or no cost at all. If you do all the work but use purchased prairie plants, a rain garden will cost approximately $3 to $5 per square foot. If a landscaper does everything, it will cost approximately $10 to $12 per square foot.

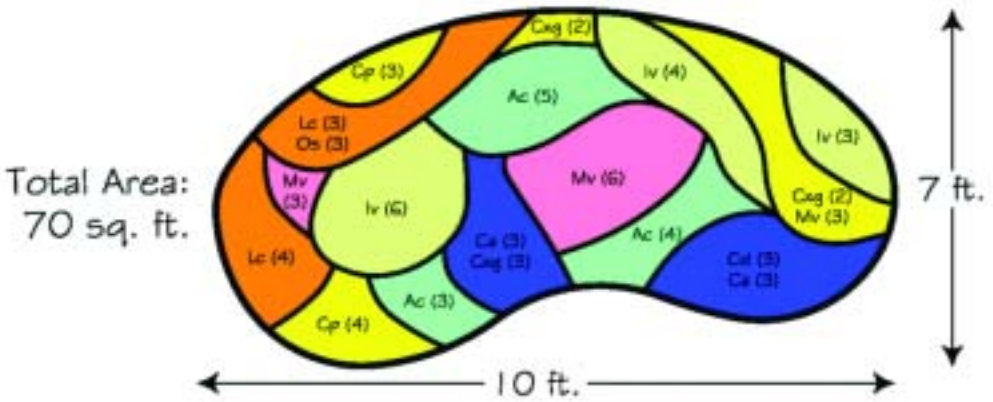
It might seem easiest to sow native wildflower seed over the garden, but experience shows that seeding a rain garden has its problems. Protecting the seeds from wind, flooding, weeds, and garden pests is very difficult, and the rain garden will be mostly weeds for the first two years. Growing plugs from seed indoors or dividing a friend's plants is much better. If you grow plugs, start them about four months before moving them to the rain garden. When the roots have filled the pot and the plants are healthy, they may be planted in the rain garden

Rain Garden Designs and Plant Lists

The following pages contain conceptual planting designs and plant lists for rain gardens with varying sun and soil conditions. Keep in mind that design possibilities for rain gardens are almost limitless. Many landscape nurseries, particularly those specializing in native plants and landscaping, can provide other ideas, designs and suggested plants.

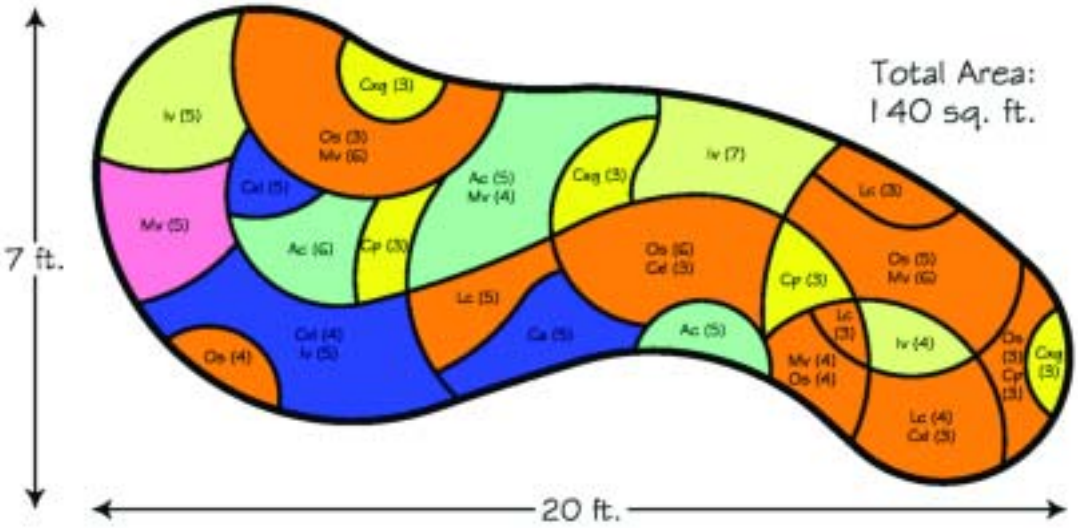
The following eight designs and plant lists have been provided by Applied Ecological Services, Inc., Brodhead, WI.

10 feet wide; full to partial shade with clay soils



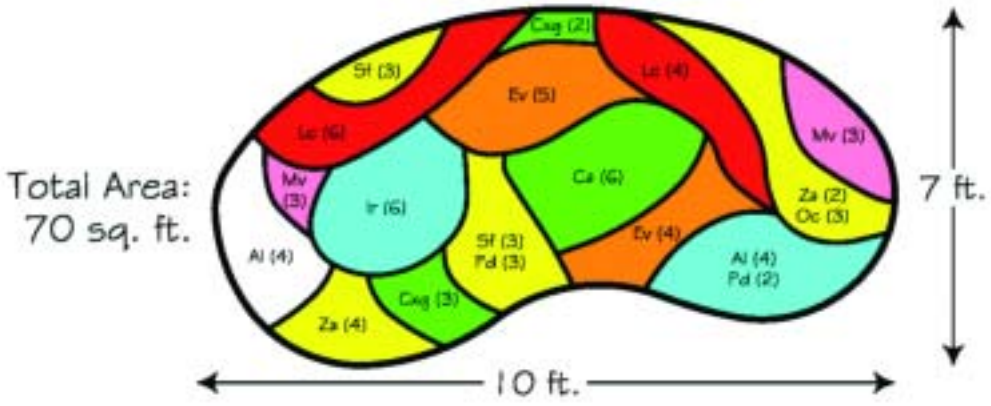
Symbol	Species Name	Common Name	No. of Plants
Ac	Acorus calamus	Sweet flag	12
Ca	Campanula americana	Tall bellflower	6
Cp	Caltha palustris	Marsh marigold	7
Cxg	Carex Grayii	Bur sedge	7
Cxl	Carex lupulina	Hop sedge	3
Iv	Iris virginica-shreveri	Wild blue flag iris	13
Lc	Lobelia cardinalis	Cardinal flower	7
Mv	Mertensia virginica	Virginia bluebells	12
Os	Onoclea sensibilis	Sensitive fern	3
		Total Plants Needed	70

20 feet wide; full to partial shade with clay soils



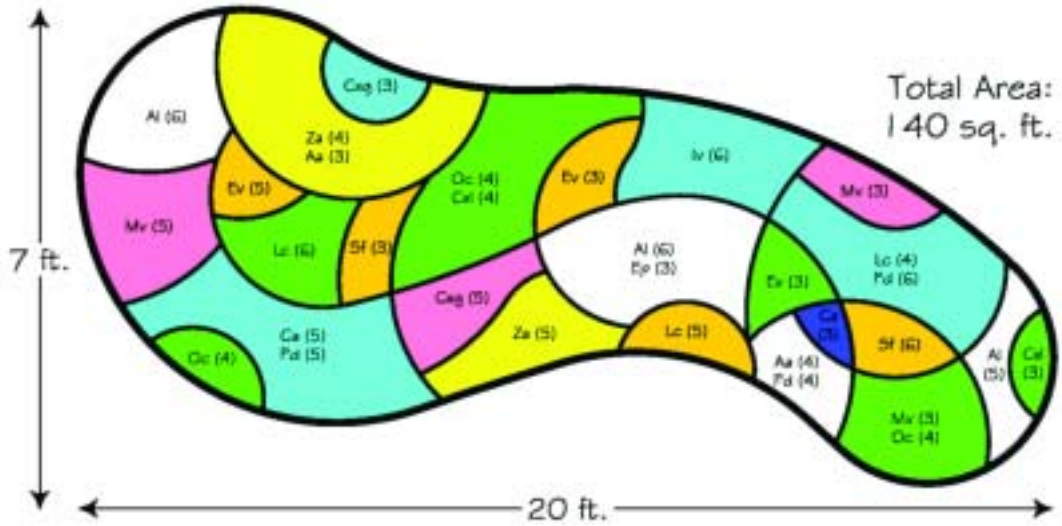
Symbol	Species Name	Common Name	No. of Plants
Ac	Acorus calamus	Sweet flag	16
Cp	Caltha palustris	Marsh marigold	9
Ca	Campanula americana	Tall bellflower	5
Cxg	Carex Grayii	Bur sedge	9
Cxl	Carex lupulina	Hop sedge	15
Iv	Iris virginica-shreveri	Wild blue flag iris	21
Lc	Lobelia cardinalis	Cardinal flower	15
Mv	Mertensia virginica	Virginia bluebells	25
Os	Onoclea sensibilis	Sensitive fern	25
		Total Plants Needed	140

10 feet wide; full to partial shade with silty & sandy soils



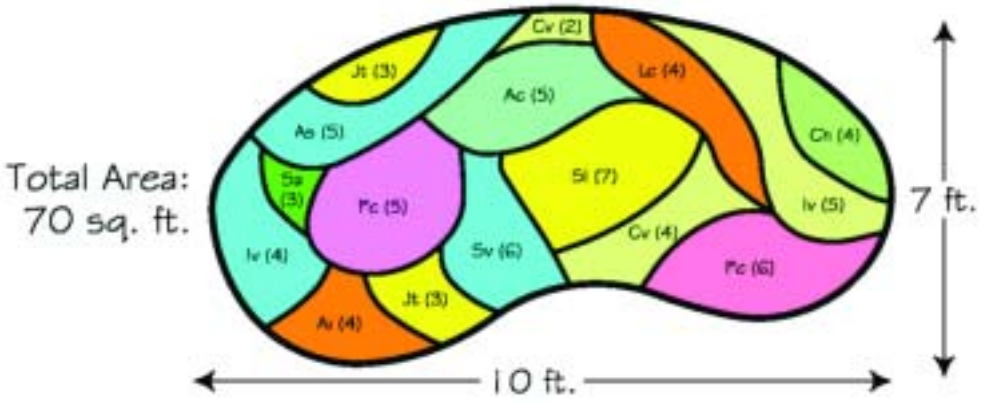
Symbol	Species Name	Common Name	No. of Plants
Al	Aster latenflorus	Side-flowering aster	8
Ca	Campanula americana	Tall bellflower	6
Cxg	Carex Grayi	Bur sedge	5
Ev	Elymus virginicus	Virginia wild rye	9
Iv	Ins virginica-shreve	Wild blue flag ins	6
Lc	Lobelia cardinalis	Cardinal flower	10
Mv	Mertensia virginica	Virginia bluebells	6
Oc	Osmunda clayoniana	Interupted fern	3
Pd	Phlox divaricata	Woodland phlox	5
Sf	Solidago flexicaulis	Zig zag goldenrod	6
Za	Zizia aurea	Golden Alexander	6
		Total Plants Needed	70

20 feet wide; full to partial shade with silty & sandy soils



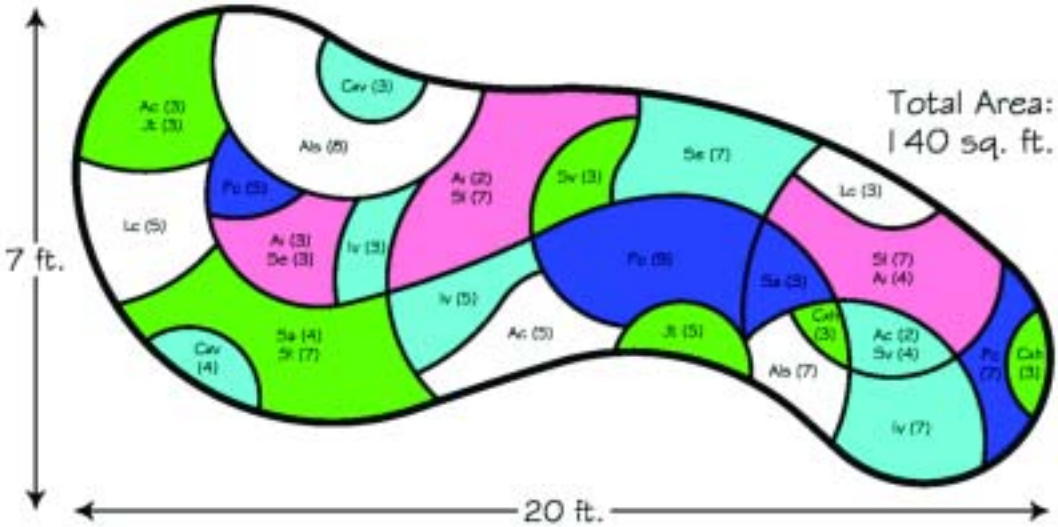
Symbol	Species Name	Common Name	No. of Plants
Aa	Ansaema atronubens	Jack-in-the-pulpit	7
Al	Aster latenflorus	Side-flowering aster	17
Ca	Campanula americana	Tall bellflower	8
Cxg	Carex Grayi	Bur sedge	8
Cxl	Carex lupulina	Hop sedge	7
Ev	Elymus virginicus	Virginia wild rye	11
Ep	Eupatorium purpureum	Purple Joe-Pye weed	3
Iv	Ins virginica-shreve	Wild blue flag ins	6
Lc	Lobelia cardinalis	Cardinal flower	15
Mv	Mertensia virginica	Virginia bluebells	11
Oc	Osmunda clayoniana	Interupted fern	12
Pd	Phlox divaricata	Woodland phlox	15
Sf	Solidago flexicaulis	Zig zag goldenrod	9
Za	Zizia aurea	Golden Alexander	14
		Total Plants Needed	143

10 feet wide; full to partial sun with clay soils



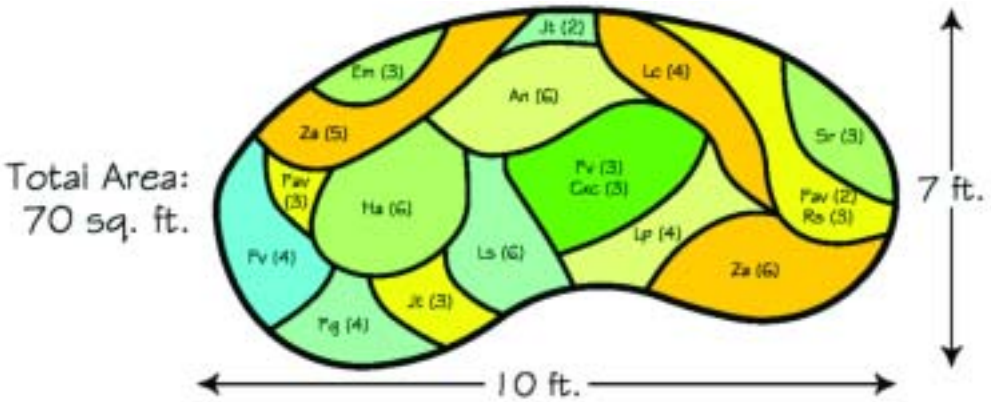
Symbol	Species Name	Common Name	No. of Plants
Ac	Acorus calamus	Sweet flag	5
As	Asclepias incarnata	Swamp milkweed	4
Als	Alisma subcordatum	Water plantain	5
Cxh	Carex hystricina	Bottle brush sedge	4
Cxv	Carex vulpinoidea	Fox sedge	6
Iv	Ins virginica-shrevei	Wild blue flag ins	9
Jt	Juncus torreyi	Torrey's rush	6
Lc	Lobelia cardinalis	Cardinal flower	4
Pc	Pontedaria cordata	Pickerel weed	11
Si	Sagittaria latifolia	Arrowhead	7
Sa	Scirpus atrovirens	Green bulrush	3
Sv	Scirpus validus creber	Soft-stemmed bulrush	6
		Total Plants needed	70

20 feet wide; full to partial sun with clay soils



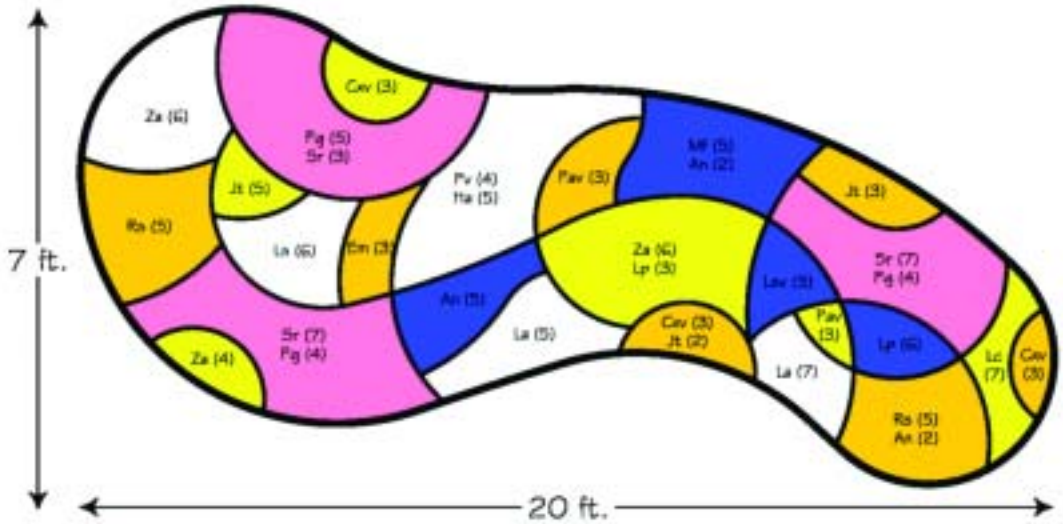
Symbol	Species Name	Common Name	No. of Plants
Ac	Acorus calamus	Sweet flag	10
Ai	Asclepias incarnata	Swamp milkweed	9
Als	Alisma subcordatum	Water plantain	15
Cxh	Carex hystricina	Bottle brush sedge	6
Cxv	Carex vulpinoidea	Fox sedge	7
Iv	Ins virginica-shreve	Wild blue flag ins	15
Jt	Juncus torreyi	Torrey's rush	8
Lc	Lobelia cardinalis	Cardinal flower	8
Pc	Pontedaria cordata	Pickerel weed	21
Si	Sagittaria latifolia	Arrowhead	21
Sa	Scirpus atrovirens	Green bulrush	7
Sv	Scirpus validus creber	Soft-stemmed bulrush	7
Se	Sparganium eurycarpum	Common bur-reed	10
		Total Plants needed	144

10 feet wide; full to partial sun with silt and sandy soils



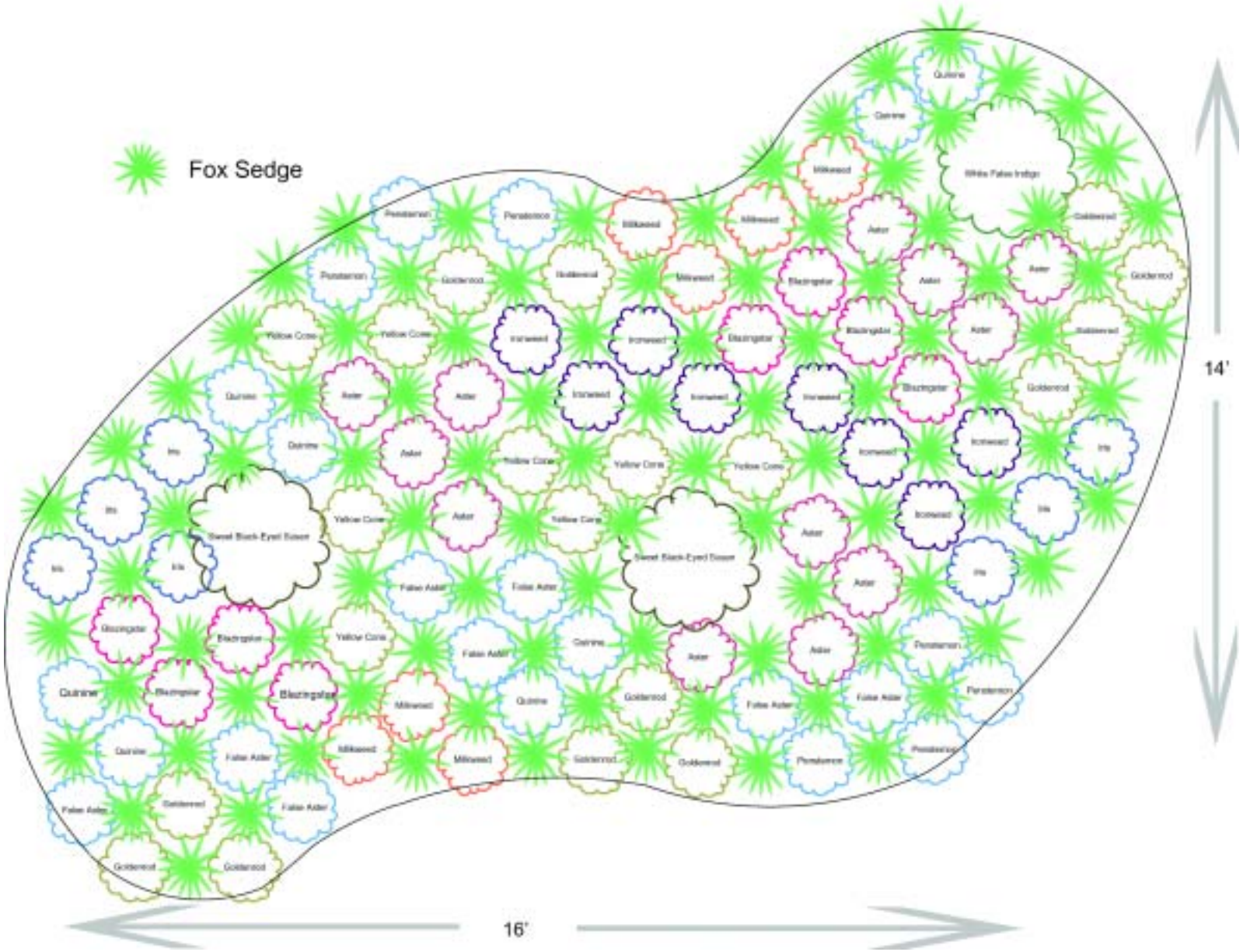
Symbol	Species Name	Common Name	No. of Plants
An	Aster novae-angliae	New England Aster	6
Cxc	Carex comosa	Bottlebrush sedge	3
Ep	Eupatorium maculatum	Spotted Joe-Pye weed	3
Ha	Helenium autumnale	Sneezeweed	6
Jt	Juncus torreyi	Torrey's rush	5
Lp	Liatris pycnostachya	Gayfeather	4
Lc	Lobelia cardinalis	Cardinal flower	4
Ls	Lobelia siphilitica	Great blue lobelia	6
Pav	Panicum virgatum	Switch grass	5
Pg	Phlox glaberrima	Marsh phlox	4
Pv	Pycnanthemum virginianum	Mountain mint	7
Rs	Rudbeckia subtomentosa	Sweet coneflower	5
Sr	Solidago Riddellii	Riddell's goldenrod	3
Za	Zizia aurea	Golden Alexander	11
		Total Plants needed	72

20 feet wide; full to partial sun with silt and sandy soils



Symbol	Species Name	Common Name	No. of Plants
An	Aster novae-angliae	New England Aster	9
Cxv	Carex vulpinoidea	Fox sedge	9
Ep	Eupatorium maculatum	Spotted Joe-Pye weed	3
Ha	Helenium autumnale	Sneezeweed	5
Jt	Juncus torreyi	Torrey's rush	10
Lp	Liatris pycnostachya	Gayfeather	9
Lc	Lobelia cardinalis	Cardinal flower	7
Ls	Lobelia siphilitica	Great blue lobelia	9
La	Lythrum alatum	Winged loosestrife	12
Mf	Monarda fistulosa	Wild Bergamot	5
Pav	Panicum virgatum	Switch grass	6
Pg	Phlox glaberrima	Marsh phlox	13
Pv	Pycnanthemum virginianum	Mountain mint	4
Rs	Rudbeckia subtomentosa	Sweet coneflower	10
Sr	Solidago Riddellii	Riddell's goldenrod	17
Za	Zizia aurea	Golden Alexander	16
		Total Plants needed	144

The following three designs and plant lists have been provided by Prairie Nursery, Inc., Westfield, WI


Fox Sedge
14'
16'

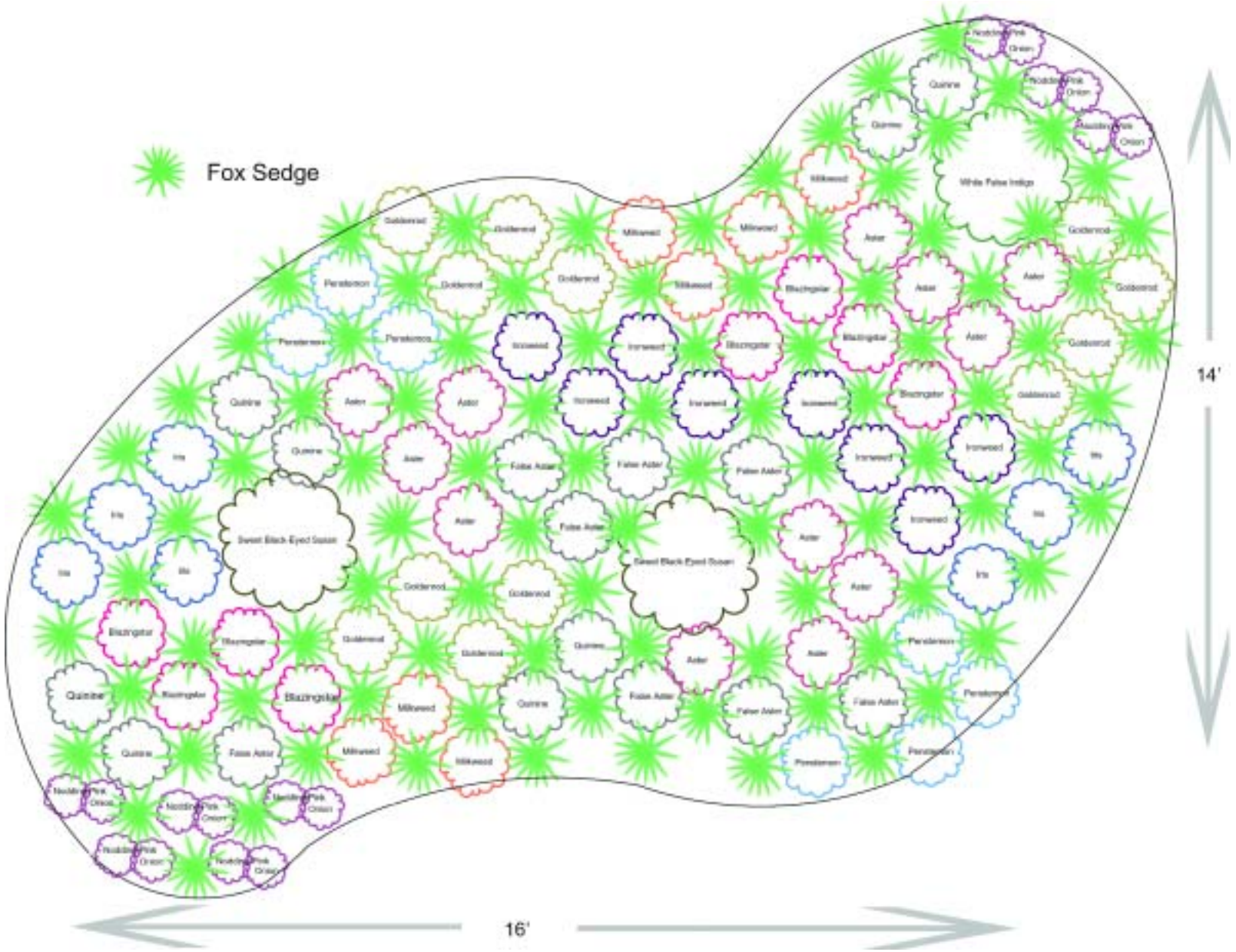
RAIN GARDEN FOR CLAY SOILS AND FULL SUN

AREA: 192 Square Feet

Designed to thrive through conditions of periodic water infiltrations as well as dry periods
Designed to control 45% of annual runoff from an average sized rooftop (500 to 700 square feet)
Install at least 10′ from your foundation, in-line with a down-spout and/or downslope to intercept the rooftop water
Depth of the garden designed to be 3.5″ to 4″ deep to hold about 200 gallons of water during periods of heavy rainfall

LATIN NAME	COMMON NAME	AMT	BLOOM TIME	BLOOM COLOR	HEIGHT	SPACING
Asclepias incarnata	Red Milkweed	7	early summer	red	3′-5′	1′
Baptisia lactea	White False Indigo	1	early summer	white	3′-5′	2′
Iris versicolor	Blue Flag Iris	7	early summer	blue	2′-3′	1′
Penstemon digitalis	Smooth Penstemon	7	early summer	white	2′-3′	1′
Liatris pycnostachya	Prairie Blazingstar	8	summer	pink	3′-5′	1′
Parthenium integrifolium	Wild Quinine	8	summer	white	3′-5′	1′
Ratibida pinnata	Yellow Coneflower	8	summer	yellow	3′-6′	1′
Boltonia asteroides	False Aster	8	late summer	white/pink	2′-4′	1′
Rudbeckia subtomentosa	Sweet Black-Eyed Susan	2	late summer	yellow	4′-6′	2′
Vernonia fasciculata	Ironweed	8	late summer	magenta	4′-6′	1′
Aster novae-angliae	New England Aster	12	fall	pink/purple	3′-6′	1′
Solidago rigida	Stiff Goldenrod	12	fall	yellow	3′-5′	1′
Carex vulpinoidea	Fox Sedge	96			1′-3′	1′

184 plants


Fox Sedge
14'
16'

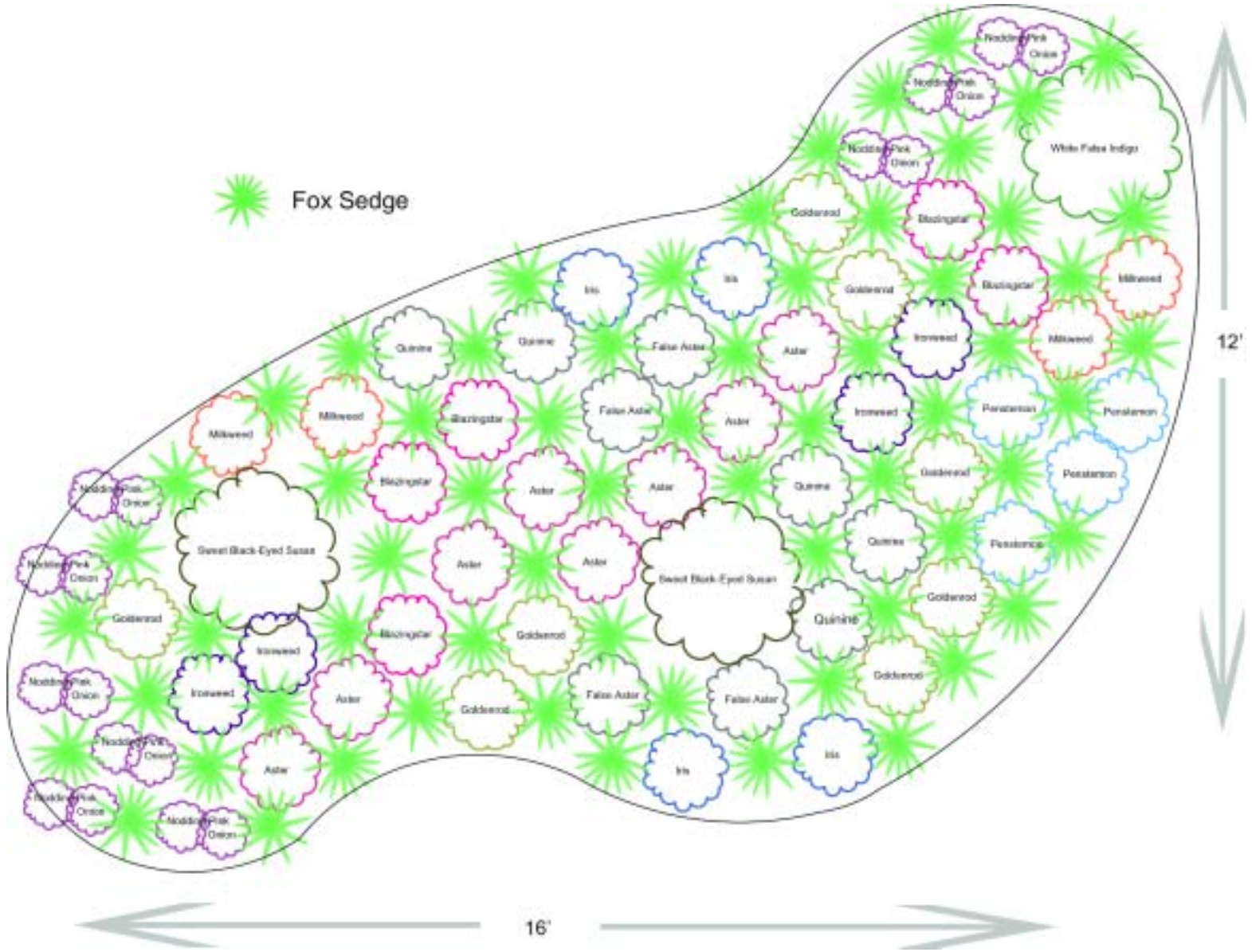
RAIN GARDEN FOR LOAM TO SANDY/LOAM SOILS AND FULL SUN

AREA: 192 Square Feet

Designed to thrive through conditions of periodic water infiltrations as well as dry periods
Designed to control 90% of annual runoff from an average sized rooftop (500 to 700 square feet)
Install at least 10' from your foundation, in-line with a down-spout and/or downslope to intercept the rooftop water
Depth of the garden designed to be 3.5" to 4" deep to hold about 400 gallons of water during periods of heavy rainfall

LATIN NAME	COMMON NAME	AMT	BLOOM TIME	BLOOM COLOR	HEIGHT	SPACING
Asclepias incarnata	Red Milkweed	7	early summer	red	3'-5'	1'
Baptisia lactea	White False Indigo	1	early summer	white	3'-5'	2'
Iris versicolor	Blue Flag Iris	7	early summer	blue	2'-3'	1'
Penstemon digitalis	Smooth Penstemon	7	early summer	white	2'-3'	1'
Allium cernuum	Nodding Pink Onion	16	summer	pink	1'-2'	6"
Liatris pycnostachya	Prairie Blazingstar	8	summer	pink	3'-5'	1'
Parthenium integrifolium	Wild Quinine	8	summer	white	3'-5'	1'
Boltonia asteroides	False Aster	8	late summer	white/pink	2'-4'	1'
Rudbeckia subtomentosa	Sweet Black-Eyed Susan	2	late summer	yellow	4'-6'	2'
Vernonia fasciculata	Ironweed	8	late summer	magenta	4'-6'	1'
Aster novae-angliae	New England Aster	12	fall	pink/purple	3'-6'	1'
Solidago ohioensis	Ohio Goldenrod	12	fall	yellow	3'-4'	1'
Carex vulpinoidea	Fox Sedge	96			1'-3'	1'

192 plants


Fox Sedge
White False Indigo
Goldenrod
Blazingstar
Iris
Goldenrod
Blazingstar
Milkweed
Ironweed
Milkweed
Penstemon
Penstemon
Penstemon
Quinine
Quinine
False Aster
Aster
Milkweed
Blazingstar
False Aster
Aster
Ironweed
Blazingstar
Aster
Aster
Goldenrod
Quinine
Sweet Black-Eyed Susan
Aster
Aster
Sweet Black-Eyed Susan
Quinine
Goldenrod
Goldenrod
Ironweed
Blazingstar
Goldenrod
Ironweed
Aster
Goldenrod
False Aster
False Aster
Goldenrod
Aster
Iris
Iris
12'
16'

RAIN GARDEN FOR SANDY SOILS AND FULL SUN

AREA: 128 Square Feet

Designed to thrive through conditions of periodic water infiltrations as well as dry periods
Designed to control 90% of annual runoff from an average sized rooftop (500 to 700 square feet)
Install at least 10' from your foundation, in-line with a down-spout and/or downslope to intercept the rooftop water
Depth of the garden designed to be 3.5" to 4" deep to hold about 400 gallons of water during periods of heavy rainfall

LATIN NAME	COMMON NAME	AMT	BLOOM TIME	BLOOM COLOR	HEIGHT	SPACING
Asclepias incarnata	Red Milkweed	4	early summer	red	3'-5'	1'
Baptisia lactea	White False Indigo	1	early summer	white	3'-5'	2'
Iris versicolor	Blue Flag Iris	4	early summer	blue	2'-3'	1'
Penstemon digitalis	Smooth Penstemon	4	early summer	white	2'-3'	1'
Allium cernuum	Nodding Pink Onion	18	summer	pink	1'-2'	6"
Liatris pycnostachya	Prairie Blazingstar	5	summer	pink	3'-5'	1'
Parthenium integrifolium	Wild Quinine	5	summer	white	3'-5'	1'
Boltonia asteroides	False Aster	4	late summer	white/pink	2'-4'	1'
Rudbeckia subtomentosa	Sweet Black-Eyed Susan	2	late summer	yellow	4'-6'	2'
Vernonia fasciculata	Ironweed	4	late summer	magenta	4'-6'	1'
Aster novae-angliae	New England Aster	8	fall	pink/purple	3'-6'	1'
Solidago ohioensis	Ohio Goldenrod	8	fall	yellow	3'-4'	1'
Carex vulpinoidea	Fox Sedge (sedge)	64			1'-3'	1'

128 plants

Special Rain Garden Locations

In addition to conventional lawns, there are other locations where rain gardens can be created. A rectangular-shaped rain garden (above) was located in a narrow sideyard between two homes. A new rain garden (below), now helps control runoff that would flow into a parking lot.

Rain garden designs and plant lists provided by John Gishnock, Applied Ecological Services, Inc. (pages 19-22) and Jennifer Baker, Prairie Nursery Inc. (pages 24-29).

RAIN GARDENS

A how-to manual for homeowners

A frosted rain garden in autumn.

This publication developed by Roger Bannerman, Wisconsin Department of Natural Resources and Ellen Considine, U.S. Geological Survey. Special thanks to John Gishnock, Applied Ecological Services, Inc., Jennifer Baker, Prairie Nursery Inc. and Joyce Powers, CRM Ecosystems Inc.

Photos by Roger Bannerman, Wisconsin Department of Natural Resources.

Layout design/production by Jeffrey Strobel, and editorial assistance by Bruce Webendorfer, University of Wisconsin–Extension Environmental Resources Center.

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The publication can also be viewed and printed from pdf format on the web at clean-water.uwex.edu/pubs/raingarden

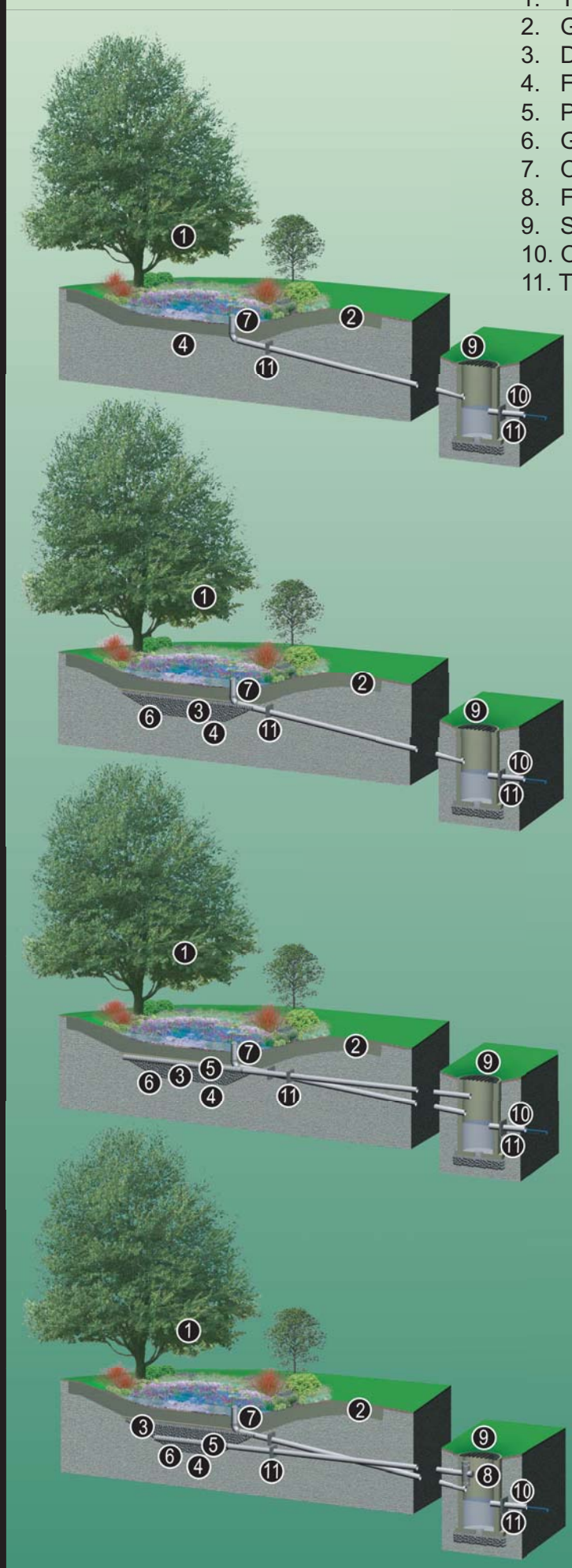
Wisconsin Department of Natural Resources
DNR Publication PUB-WT-776 2003

University of Wisconsin–Extension
UWEX Publication GWQ037
1-06-03-5M-100-S

DESIGN PRINCIPLES

- Literature suggests rain garden areas of about 10-20% of upstream impervious area. For GVRD, calculate rain garden area by continuous flow modelling. Optimum rain garden size is about 50sq.m. draining 250sq.m. of impervious area.
- Smaller, distributed rain gardens are better than single large scale facilities.
- Locate rain gardens a minimum 30.5m from wells, 3m downslope of building foundations, and only in areas where foundations have footing drains and are not above steep slopes.
- Provide pretreatment and erosion control i.e. grass filter strip to avoid introducing sediment into the garden.
- At point-source inlets, install non-erodable material, sediment cleanout basins, and weir flow spreaders.
- Bottom width - 600mm (Min.) to 3000mm (desirable). Length-width ratio of 2:1.
- Side slopes - 2:1 maximum, 4:1 preferred for maintenance. Maximum ponded level - 150 - 300mm.
- Draw-down time for maximum ponded volume - 72 hours.
- Treatment soil depth - 450mm (Min.) to 1200mm (desirable); use soils with minimum infiltration rate of 13mm/hr.
- Surface planting should be primarily trees, shrubs, and groundcovers, with planting designs respecting the various soil moisture conditions in the garden. Plantings may include rushes, sedges and grasses as well as lawn areas for erosion control and multiple uses.
- Apply a 50-75mm layer of organic mulch for both erosion control and to maintain infiltration capacity.
- Install a non-erodible outlet or spillway to discharge overflow.
- Avoid utility or other crossings of the rain garden. Where utility trenches must be constructed below the garden, install trench dams to avoid infiltration water following the utility trench.
- Drain rock reservoir and perforated drain pipe may be avoided where infiltration tests by a design professional show a subsoil infiltration rate that exceeds the inflow rate.

An **Infiltration Rain Garden** is a form of bioretention facility designed to have aesthetic appeal as well as a stormwater function. Rain gardens are commonly a concave landscaped area where runoff from roofs or paving infiltrates into deep constructed soils and subsoils below. On subsoils with low infiltration rates, Rain Gardens often have a drain rock reservoir and perforated drain system to convey away excess water.



1. Tree, Shrub and Groundcover Plantings
2. Growing Medium Minimum 450mm Depth
3. Drain Rock Reservoir
4. Flat Subsoil - scarified
5. Perforated Drain Pipe 150mm Dia. Min.
6. Geotextile Along All Sides of Drain Rock Reservoir
7. Overflow (standpipe or swale)
8. Flow Restrictor Assembly
9. Secondary Overflow Inlet at Catch Basin
10. Outflow Pipe to Storm Drain or Swale System
11. Trench Dams at All Utility Crossings

Full Infiltration

Where all inflow is intended to infiltrate into the underlying subsoil. Candidate in sites with subsoil permeability > 30mm/hr. An overflow for large events is provided by pipe or swale to the storm drain system.

Full Infiltration with Reservoir

Adding a drain rock reservoir so that surface water can move quickly through the installed growing medium and infiltrate slowly into subsoils from the reservoir below. Candidate in sites with subsoil permeability > 15mm/hr.

Partial Infiltration

Designed so that most water may infiltrate into the underlying soil while the surplus overflow is drained by perforated pipes that are placed near the top of the drain rock reservoir. Suitable for sites with subsoil permeability > 1 and < 15mm/hr.

Partial Infiltration with Flow Restrictor

For sites with subsoil permeability < 1mm/hr, the addition of a flow restrictor assembly with a small orifice slowly decants the top portion of the reservoir and rain garden. Provides water quality treatment and some infiltration, while acting like a small detention facility.

Rain Garden

Greater Vancouver Regional District

LANARC CONSULTANTS LTD

kwl

Goya Ngan
Landscape Architect

Detailed design guidelines can be found in the Design Guidelines 2005 report, available at www.gvrd.bc.ca

Stormwater Source Control Design Guidelines 2005




GENERAL DESCRIPTION

Simple downspout disconnection involves directing flow from roof downspouts to a pervious area that drains away from the building. This prevents stormwater from directly entering the storm sewer system or flowing across a "connected" impervious surface, such as a driveway, that drains to a storm sewer. Simple downspout disconnection requires a minimum flow path length across the pervious area of 5 metres.

DESIGN GUIDANCE

Roof downspout disconnections should meet the following criteria:

- Pervious areas used for downspout disconnection should be graded to have a slope of between 1 to 5%;
- Pervious areas should slope away from the building;
- The flow path length across the pervious area should be 5 metres or greater;
- The infiltration rate of soils in the pervious area should be 15 mm/hr or greater (i.e., hydraulic conductivity of 1x10-6 cm/s or greater);
- If infiltration rate of the soil in the pervious area is less than 15 mm/hr, it should be tilled to a depth of 300 mm and amended with compost to achieve a ratio of 8 to 15% organic content by weight or 30 to 40% by volume;
- If the flow path length across the pervious area is less than 5 metres and the soils are hydrologic soil group C or D, roof runoff should be directed to another LID practice (e.g., rainwater harvesting system, bioretention area, swale, soakaway, perforated pipe system);
- The total roof area contributing drainage to any single downspout discharge location should not exceed 100 square metres; and,
- A level spreading device (e.g., pea gravel diaphragm) or energy dissipating device (e.g., splash pad) should be placed at the downspout discharge location to distribute runoff as evenly as possible over the pervious area.

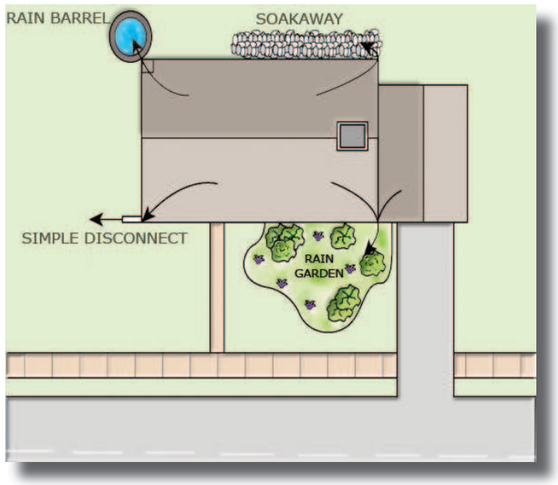
APPLICATIONS

There are many options for keeping roof runoff out of the storm sewer system. Some of the options are as follows:

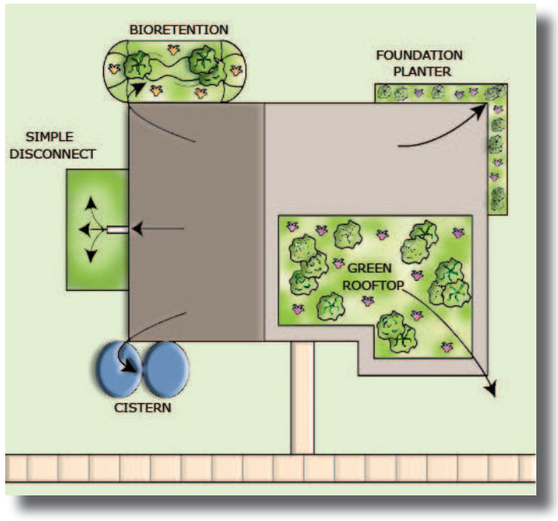
- Simple roof downspout disconnection to a pervious area or vegetated filter strip, where sufficient flow path length across the pervious area and suitable soil conditions exist;
- Roof downspout disconnection to a pervious area or vegetated filter strip that has been tilled and amended with compost to improve soil infiltration rate and moisture storage capacity;
- Directing roof runoff to an enhanced grass swale, dry swale, bioretention area, soakaway or perforated pipe system;
- Directing roof runoff to a rainwater harvesting system (e.g., rain barrel or cistern) with overflow to a pervious area, vegetated filter strip, swale, bioretention area, soakaway or permeable pavement.







RESIDENTIAL



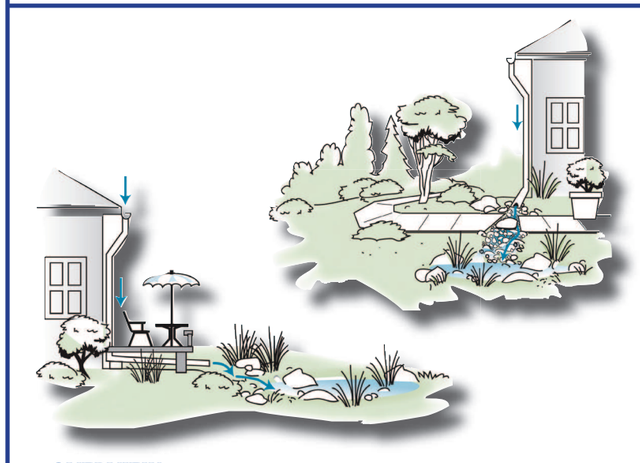
COMMERCIAL

ABILITY TO MEET SWM OBJECTIVES

BMP	Water Balance Benfit	Water Quality Improvement	Stream Channel Erosion Control Benefit
Downspout Disconnection	Partial - depends on soil infiltration rate and length of flow path over the pervious area	Partial - depends on soil infiltration rate and length of flow path over the pervious area	Partial - depends on combination with other practices

Downspout disconnection is primarily a practice used to help achieve water balance benefits, although it can also contribute to water quality improvement. Very limited research has been conducted on the runoff reduction benefits of downspout disconnection, so initial estimates are drawn from research on filter strips, which operate in a similar manner. The research indicates that runoff reduction is a function of soil type, slope, vegetative cover and filtering distance. A conservative runoff reduction rate is 25% for hydrologic soil group (HSG) C and D soils and 50% for HSG A and B soils.* These values apply to disconnections that meet the feasibility criteria outlined in this section, and do not include any further runoff reduction due to the use of compost amendments along the filter path.

*Hydrologic soil group (HSG) classifications are based on the ability of the soil to transmit water. Soil groups are ranked from A to D. Group A soils are sandy, loamy sand, or sandy loam types. Group B soils are silt loam or loam types, Group C soils are sandy clay loam types. Group D soils are clay loam, silty clay loam, sandy clay, silty clay or clay types



OVERVIEW

CONSTRUCTION CONSIDERATIONS

SOIL DISTURBANCE AND COMPACTION

Only vehicular traffic necessary for construction should be allowed on the pervious areas to which roof downspouts will be discharged. If vehicle traffic is unavoidable, then the pervious area should be tilled to a depth of 300 mm to loosen the compacted soil.

EROSION AND SEDIMENT CONTROL

If possible, construction runoff should be directed away from the proposed downspout discharge location. After the contributing drainage area and the downspout discharge location are stabilized and vegetated, erosion and sediment control structures can be removed.

OPERATION AND MAINTENANCE

Maintenance of disconnected downspouts will generally be no different than for lawns or landscaped areas. A maintenance agreement with property owners or managers may be required to ensure that downspouts remain disconnected and the pervious area remains pervious. For long-term efficacy, the pervious area should be protected from compaction. One method is to plant shrubs or trees along the perimeter of the pervious area to prevent traffic. On commercial sites, the pervious area should not be an area with high foot traffic. If ponding of water for longer than 24 hours occurs, the pervious area should be dethatched and aerated. If ponding persists, regrading or tilling to reverse compaction and/or addition of compost to improve soil moisture retention may be required.

SITE CONSIDERATIONS

Site Topography

Disconnected downspouts should discharge to a gradual slope that conveys runoff away from the building. The slope should be between 1% and 5%. Grading should discourage flow from reconnecting with adjacent impervious surfaces.

Water Table

Roof downspouts should only be disconnected where the minimum depth to the seasonally high water table is at least one (1) metre below the surface.

Pollution Hot Spot Runoff

Downspout disconnection can be used where land uses or activities at ground-level have the potential to generate highly contaminated runoff (e.g., vehicle fueling, servicing and demolition areas, outdoor storage and handling areas for hazardous materials and some heavy industry sites) as long as the roof runoff is kept separate from runoff from ground-level impervious surfaces.

COMMON CONCERNS

ON PRIVATE PROPERTY

Property owners or managers will need to be educated on its function and maintenance needs, and may be subject to a legally binding maintenance agreement. An incentive program such as a storm sewer user fee based on the area of impervious cover on a property that is directly connected to a storm sewer could be used to encourage property owners or managers to maintain existing practices.

STANDING WATER AND PONDING

Downspout disconnection is not intended to pond water, so any standing water should be infiltrated or evaporated within 24 hours of the end of each runoff event. If ponding for longer than 24 hours occurs, mitigation actions noted under Operation and Maintenance should be undertaken.

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DOWNSPOUT DISCONNECTION

TORONTO AND REGION Conservation for The Living City

CVC CREDIT VALLEY CONSERVATION

FOR FURTHER DETAILS SEE SECTION 4.3 OF THE CVC/TRCA LID SWM GUIDE